

## SECTION 434120

### SHOP FABRICATED TANKS – ATMOSPHERIC

#### PART 1 – GENERAL

##### 101. EXTENT

- 101.1 This Section prescribes the minimum requirements for the material, design, fabrication, and testing shop fabricated tanks, complete with accessories. The CONTRACTOR shall conform to the requirements of this Section and to the requirements indicated on the design drawings.
- 101.2 CONTRACTOR shall provide, but not necessarily be limited to, design, fabrication, delivery, installation support and service for the shop-fabricated tanks and accessories specified.
- 101.3 The tanks and accessories shall conform to the requirements of the governing Code(s); in other respects, tanks shall conform to the requirements of this Section and shall satisfy all conditions and requirements of the specification.
- 101.4 In the event of variance between the general requirements delineated in this Section and the particular requirements set forth in the specification, the specification shall take precedence.
- 101.5 CONTRACTOR shall be solely responsible for advising the DISTRICT's Project Engineer in writing of any conflicts between the specification and CONTRACTOR's design, including performance and levels of quality. CONTRACTOR agrees that its obligations, liabilities and warranties shall not be diminished or extinguished due to its meeting the requirements of the specification.

##### 102. RELATED WORK SPECIFIED IN OTHER SECTIONS

- 102.1 The work specified in this Section shall be coordinated with work specified in the following related Sections:
- a. Section 014219 - Reference Documents
  - b. Section 441130 – Wet Flue Gas Desulfurization System

##### 103. REFERENCE DOCUMENTS

- 103.1 Standards, specifications, manuals, codes and other publications of nationally recognized organizations and associations are referenced herein. Methods, equipment and materials specified herein shall comply with the specified and applicable portions of the referenced documents indicated in Section 014219, in addition to federal, state or local codes having jurisdiction. References to these documents are to the latest issue date of each document, unless otherwise indicated, together with the applicable additions, addenda, amendments, supplements, thereto, in effect as of the date indicated in Section 014219.
- 103.2 API - American Petroleum Institute:
- a. 620 - Design and Construction of Large, Welded, Low-Pressure Storage Tanks
  - b. 650 - Welded Steel Tanks for Oil Storage

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- 103.3 ASME - American Society of Mechanical Engineers:
- a. B16.5 - Steel Pipe Flanges, Flanged Vales and Fittings
  - b. B31.1 - Power Piping Code
  - c. B96.1 - Welded Aluminum-Alloy Storage Tanks - No Replacement
  - d. Boiler and Pressure Vessel Code, Section VIII, Division I
  - e. Boiler and Pressure Vessel Code, Section IX
- 103.4 ASTM - ASTM International:
- a. A 27/A 27M - Standard Specification for Steel Castings, Carbon, for General Application
  - b. A 36/A 36M - Specification for Carbon Structural Steel
  - c. A 53/A 53M - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - d. A 105/A 105M - Specification for Carbon Steel Forgings for Piping Applications
  - e. A 106/A 106M REV A - Specification for Seamless Carbon Steel Pipe for High-Temperature Service
  - f. A 181/A 181M- Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
  - g. A 182/A 182M - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
  - h. A 216/A 216M - Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service
  - i. A 234/A 234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
  - j. A 240/A 240M - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
  - k. A 285/A 285M - Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
  - l. A 312/A 312M- Specification for Seamless and Welded Austenitic Stainless Steel Pipes
  - m. A 351/A 351M- Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
  - n. A 376/A 376M - Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
  - o. A 403/A 403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
  - p. A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

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- q. A 516/A 516M - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
- r. B 26/B 26M- Specification for Aluminum-Alloy Sand Castings
- s. B 241/B 241M- Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
- t. B 247 Rev. A - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings
- u. B 308/B 308M- Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
- v. B 361 - Standard Specification for Factory-Made Wrought Aluminum and Aluminum-Alloy Welding Fittings
- w. 4618-92 – Standard for Design and Fabrication of Flue Gas Desulfurization System Components for Protective Lining Application
- 103.5 AWS - American Welding Society:
  - a. A5.1/A5.1M - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
  - b. A5.4/A5.4M - Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding
  - c. A5.10/A5.10M - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods
- 103.6 NEMA - National Electrical Manufacturers Association
- 103.7 SSPC – The Society for Protective Coatings:
  - a. SP 1 – Solvent Cleaning
  - b. SP 2 – Hand Cleaning
  - c. SP 3 – Power Tool Cleaning
  - d. SP 5 - White Metal Blast Cleaning
  - e. SP 6 – Commercial Blast Cleaning
  - f. Paint Application Specification No.1, Shop, Field and Maintenance Painting.
- 103.8 UL - Underwriters' Laboratories:
  - a. 58 – UL Standard for Safety Steel Underground Tanks for Flammable and Combustible Liquids
  - b. 142 - UL Standard for Safety Steel Aboveground Tanks for Flammable and Combustible Liquids
- 104. SUBMITTALS
- 104.1 Submit documents for review in accordance with Section I – Contract Drawing and Data Requirements.
- 104.2 Required Procedures and Documentation:

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- a. Procedures to be used on the work for welding, nondestructive examinations, hydrostatic testing, and cleaning are to be submitted to the DISTRICT's Project Engineers for review prior to start of work.
- b. Chemical and physical reports, radiography film, results of all non-destructive examinations, and hydrostatic testing shall be submitted to the DISTRICT's Project Engineers for review.

105. GENERAL QUALITY CONTROL AND QUALITY ASSURANCE PROVISIONS

See section 014500 – Quality Control.

106. PROJECT/SITE CONDITIONS

See section 011900 – Site Design Data.

**PART 2 - PRODUCTS**

201. ACCEPTABLE MANUFACTURERS AND PRODUCTS

Refer to section 012513 – Acceptable Suppliers and Product Substitutions.

202. COMPONENTS

- 202.1 Construction of tanks shall conform to all federal, state, and local codes having jurisdiction and to the specific codes hereinafter referenced.
- 202.2 The tanks shall be designed, constructed, erected, and tested in accordance with the requirements of the industry standards, including any additional requirements that may be specified herein. Tank material, configuration, and service conditions shall determine the applicable industry standard.
- 202.3 Tank selection and design will be by CONTRACTOR based on the conditions and services specified in section 441130.
- 202.4 CONTRACTOR shall perform all calculations necessary to ensure the integrity of each tank and shall carefully check the design and provide proper plate thickness, reinforcement and supports as required for the service for which each tank is intended. Calculations shall be in sufficient detail to permit independent checking.
- 202.5 The overturning moment applied to the shell from the response of the tank liquid mass shall be included in the design calculation.
- 202.6 CONTRACTOR shall design tanks for all loads applicable: seismic loads, dead loads and live loads (including hydrostatic pressure). Loading parameters are specified in Section 011900, Site Design Data.
- 202.7 Thickness of structural shapes shall not be less than 1/4 inch.
- 202.8 All flanges shall be in accordance with ANSI B16.5 and shall extend a minimum of 6 inches from the tank shell.
- 202.9 All tanks shall be fully enclosed and vented to the atmosphere.

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- 202.10 All tanks shall be so designed to have the ability to be moved as a unit. A minimum of two lifting lugs shall be provided each tank. One lifting lug shall be capable of supporting the entire unit. Additional lugs, as required, shall be provided so that the tanks may be pulled horizontally when required.
- 202.11 Steel tanks shall be of welded construction. External platforms, handrails, ladders for access to tank roof manholes and piping fasteners inside the tank, if required, shall be of carbon steel and their attachment to the tank shall be by welding brackets fabricated from material of similar composition to that of the tank shell.
- 202.12 The bottom of any flat bottomed tank shall be sloped towards the outlet drain connection for gravity draining of the tanks.
- 202.13 Supports
- a. All raised vertical tanks shall be provided with support legs or skirts and anchor plates and flat bottom tanks shall have anchor chairs or rings for bolting to floor or foundation. Supports for raised vertical tanks shall be tangent welded, to the tank and designed to position the low-point of the tank approximately 24 inches above the floor. All interior stiffeners shall be provided with drainage holes.
  - b. All tanks shall be self supporting between supports.
- 202.14 The reinforcement of openings in the shell (including for piping loads) shall be designed in accordance with the rules of the applicable code. Each reinforcing pad, or segments if more than one piece is used, shall be provided with two threaded "telltale" holes drainable for hydrostatic test connection.
- 202.15 Longitudinal joints in the shell shall be located to clear openings and corresponding reinforcements.
- 202.16 Circumferential joints in the shell shall clear openings and reinforcements when possible. When openings must be located in these joints and reinforcing pads are required, the circumferential weld shall be ground flush and examined before the pad is attached.
- 202.17 Any special requirements for relief valves shall be specified.
- 202.18 Vertical Tanks:
- a. Flat bottom tanks at atmospheric pressure industry standards:
    - a1. Carbon steel for general service - Design, construction, erection, and testing per API-650.
    - a2. Aluminum for condensate service per ASME B96.1.
    - a3. Oil storage in accordance with API-650, Appendix J, and UL-142.
    - a4. Flammable and combustible fluid storage in accordance with UL-142.
  - b. Tanks symmetrical about the vertical axis at pressures up to 15 psig industry standards:
    - b1. Carbon steel - Design, construction, erection, and testing per API-620.
    - b2. Stainless steel and aluminum - Design, construction, erection, and testing per API-620.
- 202.19 Shop-fabricated horizontal tank for flammable and combustible fluid storage underground per UL-58, above ground per UL-142.

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- 202.20 Non-Standard Applications:
- a. There is no industry code for many tank configurations, service conditions, and materials. Consequently, the industry codes as hereinbefore indicated shall be used as a basis for design, construction, erection, and testing.
  - b. In general, these are minimum standards. CONTRACTOR shall carefully consider each application and take into account those problems specific to the application which may not be addressed in the industry codes.
  - c. Tanks designed in accordance with this Article need not bear the ASME stamp or the API monogram as applicable. Manufacturer's certification or data report need not be submitted.
  - d. For nonstandard applications, CONTRACTOR may propose nationally recognized design standards other than those covered above and shall clearly identify any alternate standard to the DISTRICT. Alternate design standards are subject to review by the DISTRICT's Project Engineers.
- 202.21 Corrosion Allowance:
- a. The calculated thickness of all carbon steel materials in contact with water shall include a minimum 1/16 inch corrosion allowance. The corrosion allowance for beams and channels shall be added to the webs only, not the flanges.
  - b. The minimum nominal thicknesses for carbon steel materials in contact with water shall also include the 1/16 inch corrosion allowance if required by the applicable industry code or if no calculation is performed to establish the thickness.
  - c. The minimum nominal thickness of the bottom plate of fully supported flat-bottomed vertical tanks shall not be increased.
- 202.22 If stated herein, a minimum corrosion allowance shall be used for other applications. This Specification will cover the following information regarding minimum corrosion allowance:
- a. Whether the minimum nominal plate thickness is to be increased.
  - b. Which portions of the tanks are to be considered.
- 202.23 The corrosion allowances specified herein are minimum values. CONTRACTOR shall add any additional allowance required for the service.
- 202.24 CONTRACTOR shall perform all calculations necessary to ensure the integrity of each tank and shall carefully check the design and provide proper plate thickness, reinforcement and supports as required for the service for which each tank is intended. Calculations shall be in sufficient detail to permit independent checking.
- 202.25 Internal Roof Supports: Internal roof support columns (when required) shall be fabricated from material of circular cross-section, such as pipe. The column shall be supported on a plate of suitable thickness and size such that the bearing pressures are within allowable values. There shall be no reinforcing braces or other crud traps extending out from the base of the column.

- 202.26 Horizontal Atmospheric Tanks:
- a. When stiffening rings are used, they shall be attached to the shell with a continuous fillet weld in accordance with ASME Code requirements. All stiffening rings shall be shown on CONTRACTOR's drawings. Internal stiffening rings shall not be used without DISTRICT's Project Engineers' prior acceptance. Internal stiffening rings shall have drainage ports.
  - b. Except as hereinafter specified, the minimum nominal thickness shall be ¼ inch for the shell and the heads.
- 202.27 Inflow and outflow capacities shall be as stated herein. Air venting capacity shall equal or exceed the inflow or outflow capacity, whichever is larger. Overflow capacity shall exceed the inflow capacity.
- 202.28 Insulated tanks will have an insulation thickness to appropriately insulate the tank depending on the service. Appurtenances attaching to the tank exterior shall be lengthened a corresponding amount if required to compensate for the insulation thickness.
- 202.29 Tank material, configuration, and service conditions shall determine the applicable industry standard.
- 202.30 Design of all tanks shall satisfy all performance conditions specified in this Section and data sheets.
- 202.31 The number and size of nozzles, manholes, ladders or stairways, and supports shall be as required for the tank application.
- 202.32 Tanks shall be furnished complete with all required nozzles, vents, drains, and flanges; manholes and access openings with covers, gaskets and bolting; ladders; platforms; handrailing; inside piping with suitable supports, if required; and such braces, brackets, legs, etc., as required, including all other.
- 202.33 The objective shall be to design the tanks for the specified life as stated in this Section accounting for corrosion, erosion, and material fatigue.
- 202.34 CONTRACTOR shall perform all calculations necessary to ensure the integrity of each tank and shall carefully check the design and provide proper plate thickness, reinforcement and supports as required for the service for which each tank is intended. Calculations shall be in sufficient detail to permit independent checking.
- 202.35 Tanks shall be of all-welded construction and the wetted surfaces shall be designed to withstand an internal pressure equal to a column of liquid 10 feet higher than the liquid level in the tank when filled.
- 202.36 Tanks fabricated from stainless steel shall have a minimum 3/16 inch thick wall.
- 202.37 Attachments: Where the tank is fabricated of stainless steel, a stainless steel pad of adequate thickness shall be provided between dissimilar materials at points of attachment. If the carbon steel part is to be welded to the tank in the field, the stainless steel pad shall be welded to the part in the shop so that welds of only similar materials are made in the field.
- 202.38 Shop-fabricated tanks shall be shipped in one piece. References herein to fieldwork on shop-fabricated tanks shall apply to the CONTRACTOR who erects the tank.
- 202.39 Additional Requirements:
- a. Nozzles and Pipe:

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- a1. All internal or external piping and all tank nozzles and nozzles flanges (where required) and all manholes shall be of the same base material as the tank shell, unless otherwise specified herein.
- a1.1 Nozzles and pipe for carbon steel and aluminum tanks shall be as follows, except where conditions require heavier wall thickness:
  - a1.2 Sizes 2 inches NPS and smaller: Schedule 80
  - a1.3 Sizes 2-1/2 inches to 10 inches NPS inclusive: Schedule 40
  - a1.4 Sizes 12 inches and larger: 3/8 inch wall
- a2. Nozzles and pipe for stainless steel tanks shall be as follows, except where conditions require heavier wall thickness:
  - a2.1 Sizes 12 inches NPS and smaller: Schedule 40S
  - a2.2 Sizes 14 inches and larger: 3/8 inch wall
- a3. Flanges, where shown for flanged nozzle terminals, shall conform in dimensions and drilling to ASME B16.5 for Class 150 flanges. Flanges shall be of the welding neck or slip-on type. Aluminum flanges shall be flat face. Bolt holes shall straddle the tank centerline, and the contact faces shall be exactly perpendicular to the pipe axis.
- a4. Weld-end nozzle terminals for carbon steel, stainless steel, and aluminum tanks shall be as follows:
  - a4.1 Sizes 2 inches NPS and smaller: Socket-weld end.
  - a4.2 Sizes 2-1/2 inches NPS and larger:
    - a4.2.1 Carbon and stainless steel: Per MSDE-2.1.8.3 and MSDE-2.1.8.4.
    - a4.2.2 Aluminum: Per MSDE-2.1.8.2 with dimensions A, B, C and T as shown on MSDE-2.1.8.5. (Note: Aluminum weld end nozzles will normally be used only when the connecting pipe by others is aluminum. Tank nozzle connections shall normally be flanged when the connecting pipe (by others) is carbon or stainless steel).
- a5. Connecting pipe wall thickness will be per Article a1.1 and Article a2. If the tank nozzle has an extra strong or heavier wall, CONTRACTOR shall grind the welding end land of the nozzle to match connecting pipe. Tapering of the nozzle from the welding end land to the nozzle ID shall be in accordance with ASME B31.1, Figure 127.4.2.
- a6. Fittings, where required, shall be of the same material, and of the same or greater wall thickness as the connecting pipe.
- a7. Inlet nozzles shall extend inside the tank 1/2 inch to provide a drip lip. This requirement is waived where it interferes with the application of the tank lining. Outlet or drain nozzles located in the bottom of tanks shall be designed with no internal lip so that complete drainage is obtained.
- a8. The forces and moments imposed by the nozzles on the tanks shall be as specified herein.

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- a9. All nozzles shall be furnished as required. CONTRACTOR shall also furnish such small socket welding couplings as may be required. The DISTRICT's Project Engineers will indicate the exact nozzle locations on the return of the first submittal of the CONTRACTOR's shop drawings.
- b. Manholes and Handholes, Etc.:
  - b1. Gaskets for joints between manholes, or handholes and covers shall be as follows, unless otherwise specifically required:
    - b1.1 Chemical Tanks: Rubber
    - b1.2 All Other Tanks: Composition Non-Asbestos
  - b2. Gaskets shall be so arranged as to avoid damage to the gasket material when manhole or handhole covers are removed and replaced.
  - b3. Where manholes are required on vertical tanks, there shall be two manholes in the tank shell and one manhole in the roof. The shell manholes shall be diametrically opposite. Shell manholes shall be at least 24 inches.
  - b4. All horizontal tanks shall have one manhole with hinged locking cover. Tanks with 3000-gallon capacity shall have at least 18 inch manholes. Larger capacity tanks shall have at least 24 inch manholes.
- c. Instrument Nozzles:
  - c1. If permitted by tank design, side-entering level instrument nozzles shall not be more than 6 inches above the bottom of the tank.
  - c2. Instrument nozzles penetrating the lower head of cone or dished-bottom tanks shall be installed in a horizontal position, sloped to drain into the tank, and cut off square not less than 2 inches inside the tank.
- 202.40 Accessories and Appurtenances:
  - a. Internal Piping:
    - a1. Internal piping refers to heating coils, cooling coils, air sparger piping and hydraulic mixer piping, and bubbler or pressure pipe for level instruments.
    - a2. Internal piping shall be located and supported to provide for necessary expansion and contraction. Supports shall be designed to withstand reaction forces from mixers and forces from maintenance activity by workers in the tank.
    - a3. Unless otherwise specified, all internal piping below the overflow shall be joined by welding, except internal piping in lined tanks may be flanged to allow installation through the manhole, if the lining application cannot be made with the internal piping in place.
    - a4. Internal piping shall be bolted to supports to, permit easy replacement.
    - a5. Internal piping support brackets in unlined tanks shall be of the same material as the tank shell. If the tank is lined, the support brackets shall be of stainless steel or coated to match the tank lining. Carbon steel support brackets shall be a minimum of 3/8 inch thick.

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- b. Hydraulic Mixers (if required):
    - b1. Tank contents will be recirculated through the mixer by a pump at the flow rate and head determined by CONTRACTOR.
    - b2. Mixers shall be sized and properly located by CONTRACTOR to attain uniform mixing in minimum time with indicated flow.
    - b3. CONTRACTOR shall be responsible for furnishing a suitable mixer for each application
  - c. Air Spargers (if required):
    - c1. Spargers shall be designed for uniform mixing of the tank contents using the specified minimum airflow per square foot of projected area above the sparger, which shall be defined by CONTRACTOR.
    - c2. Spargers shall be located sufficiently close to the bottom of the tank, by contouring, if necessary, to keep solids in suspension.
    - c3. Air holes shall be a minimum 1/8 inch diameter to prevent plugging by dirt in the supply air and piping. Air holes shall face downward at least 45 degrees from the horizontal plane.
    - c4. Spargers shall encompass (as much as possible) the maximum horizontal tank area.
    - c5. Header shall be enclosed with 60-mesh stainless steel screen to prevent particulates from entering 1/8 inch air holes.
  - d. Spray System (if required): Spray system shall be provided in top of tank and shall be designed to successfully wash the walls of solids with the specified water rate.
  - e. Tank Ground: Two electrical pads shall be mounted on each tank located outdoors, as specified herein, for connection to DISTRICT's ground grid. Grounding pads shall be located at opposite ends of horizontal tanks and 180° apart on vertical tanks.
- 202.41 Tank Diaphragms (if required):
- a. Tanks shall be equipped with nonpermeable, nonflammable membranes. The membranes shall be suitable for the temperature and pressure listed herein and in the data sheets.
  - b. Diaphragms shall be affixed to the roofs of the tanks with care to prevent localized overstressing and distorting of the diaphragms. The diaphragms shall be leak-tested with air pressure on the tank at the design pressure of the tank.
  - c. Electric Heaters (if required):
    - c1. CONTRACTOR will be responsible for furnishing and incorporating in the design and fabrication of the tank, electric heaters as herein specified. CONTRACTOR shall supply 480-volt AC, 3-phase, 60 Hz, Calrod immersion heaters as manufactured by General Electric Company, with a corrosion-resistant metallic flange and as called for in this Section. The heater elements shall have inconel sheaths and shall be equipped with corrosion-resistant metallic NEMA-4 terminal boxes. Each heater is to be supplied with an overheat thermocouple. CONTRACTOR shall also supply an overheat temperature controller which will convert the thermocouple output signal to an output contact (normally closed, open on increasing temperature) that will prevent damage by high heater-sheath

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- temperatures. The thermocouple leads shall be of sufficient length to reach the overheat temperature controller. The output contacts will be wired (by others) to deenergize the heaters.
- c2. CONTRACTOR shall also furnish a temperature controller for the heaters, which shall be activated by a sensing bulb to be located in a thermowell (location and type to be determined by CONTRACTOR so that optimum tank heater control characteristics are obtained). The overheat temperature controller and the temperature controller shall be mounted by CONTRACTOR on the tank near the heaters in a corrosion-resistant metallic NEMA-4 enclosure.
  - c3. The heaters shall be located near the bottom of the tanks and installed by CONTRACTOR through the sides of the tanks with necessary provisions so that elements are accessible and removable without draining the tanks and so that the maximum allowable sheath temperatures are not exceeded. CONTRACTOR shall furnish auxiliary contacts to actuate DISTRICT's low-temperature alarms. Contact rating shall be as specified in this Section.
- 202.42 Electrical Requirements:
- See Division 26.
- 202.43 Instrumentation and Control Requirements:
- All necessary instrumentation and controls shall be supplied by CONTRACTOR along with necessary logic diagrams to be incorporated into DISTRICT's DCS.
203. MATERIAL REQUIREMENTS
- 203.1 Plate:
- a. Carbon Steel: ASTM A 285 Grades B or C, A516 all grades and A 36. Alternate materials will be considered by the DISTRICT's Project Engineers.
  - b. Stainless Steel: ASTM A 240 Type 304, 304L, 316, or 316L
  - c. Aluminum: ASTM B 209 Alloy 5454 Temper H112
- 203.2 Pipe:
- a. Carbon Steel: ASTM A 106 Grade A or B; ASTM A 53 Grade B
  - b. Stainless Steel: ASTM A 312 or ASTM A 376, Grades TP304, TP304L, TP316, and TP316L
  - c. Aluminum: ASTM B 241 Alloy 6061-T6
- 203.3 Castings:
- a. Carbon Steel: ASTM A 216 Grade WCB; ASTM A 27 Grade 60-30
  - b. Stainless Steel: ASTM A 351 Grade CF8 or CF8M
  - c. Aluminum: ASTM B 26 – Alloy SG70A (A. A. No. 356) or as reviewed by the DISTRICT's Project Engineers.
- 203.4 Fittings:

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- a. Carbon Steel: ASTM A 105 or A 234 Grade WPB
  - b. Stainless Steel: ASTM A 403 Grade WP/WPW 304 or 316
  - c. Aluminum: ASTM B 247 or ASTM B 361 Alloy 6061-T6
- 203.5 Forgings:
- a. Carbon Steel: ASTM A 105 or A 181 Class 60 or 70
  - b. Stainless Steel: ASTM A182 Grade 304, F304L, F316, or F316L
  - c. Aluminum: ASTM B 247 or B 361 Alloy 6061-T6
- 203.6 Welding Electrodes:
- a. Carbon Steel: AWS A5.1
  - b. Carbon steel to stainless steel welds shall be made within AWS-A5.4 E309 stainless steel rod.
  - c. Type 304 SS, AWS A5.4 Type E308
  - d. Type 304L SS, AWS A5.4 Type E308L
  - e. Type 316 SS, AWS A5.4 Type E316
  - f. Type 316L SS, AWS A5.4 Type E316L
  - g. Aluminum: AWS A5.10 compatible with the parent alloy or alloy combination, as acceptable to the DISTRICT's Project Engineers.
- 203.7 Structural Supports:
- a. Carbon Steel: ASTM A 36
  - b. Aluminum: ASTM B 308 Alloy 6061-T6
- 203.8 Mixing Educators (if required):
- a. Carbon Steel Tanks: Cast iron or bronze.
  - b. Stainless Steel and Aluminum Tanks: 316 stainless steel.
- 203.9 Fasteners: U-bolts or other fasteners in carbon steel tanks shall be of carbon steel having a minimum diameter of 3/8 inch. In all other tanks U-bolts shall be 304 or 316 stainless steel, of diameter to suit with hardened 400 series nuts.
- 203.10 Inspection and Testing:
- a. Radiography:
    - a1. All radiography shall be in accordance with the procedures and shall comply with the acceptance standards referenced in the industry standards hereinbefore listed. Applicability of industry standards is determined by tank material, configuration, and service conditions.

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- a2. Spot radiography shall be modified as follows:
  - a2.1 One radiograph shall be taken in the first 10 feet of weld in each vessel and one spot shall be examined for each additional 50 feet of full-penetration butt welds, or fraction thereof.
  - a2.2 At least 2 intersections of vertical and horizontal joints on each tank, when they exist, shall be included in the radiographs.
  - a2.3 All films shall be subject to the DISTRICT's Project Engineers' review and comment.
  - a2.4 CONTRACTOR shall hold film for 5 years. At the expiration of the holding period, CONTRACTOR shall contact the DISTRICT for instructions regarding disposition of the film.
- b. Leak Testing:
  - b1. Each completed tank shall be leak-tested following fabrication, but prior to painting, coating, or lining the interior. DISTRICT will furnish the water for testing field-erected tanks at a source specified herein.
  - b2. The tank shall be filled with water and inspected frequently during filling. Closed-top tanks containing solutions with specified gravities greater than 1.0 shall be tested by using a standpipe to produce the equivalent pressure on the tank bottom.
  - b3. If water is not available for testing, all joints shall be tested with a vacuum box and soap solution. The gauge on the box shall register a partial vacuum. The differential pressure across the joints shall be at least 5 psi.
  - b4. The bottom joints of vertical tanks where the underside of the bottom plate is not accessible shall be tested with a vacuum box and soap solution prior to hydrotesting. If the underside is accessible, the joints shall be inspected using the magnetic particle method.
  - b5. Heating and cooling pipe coils shall be hydrostatically tested at 1-1/2 times the specified design pressure.
  - b6. Any leaks detected during hydrotesting or vacuum testing shall be repaired by procedures reviewed by the DISTRICT's Project Engineers.
  - b7. CONTRACTOR shall provide (and remove after use) necessary test pump and temporary piping, valves, blind flanges, etc., for filling and draining the tanks. CONTRACTOR shall drain the tank as dry as possible by gravity flow and pumping. Disposal of the test water shall be as stated herein. In the event the hydrotest water does not completely drain or leaves a residue on the tank interior, removal and disposal of the remaining test water and residue shall be as specified herein.
  - b8. Stainless steel tanks shall be tested with demineralized water or water whose chloride content is less than one part per million. Aluminum tanks shall be tested with demineralized water.
- c. Liquid Penetrant Examination:
  - c1. All welded joints in stainless steel tanks, including nozzle welds, shall be inspected by this method.
  - c2. All liquid penetrant testing shall be per the ASME Code, Section VIII, Appendix 8, and as approved by the DISTRICT's Project Engineers.

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- c3. All nozzle welds shall be inspected, both inside and outside the tank, by the liquid penetrant method.
- c4. Welds on all internal piping shall be tested by the liquid penetrant method.
- c5. All unacceptable defects shall be repaired by procedures reviewed and accepted by the DISTRICT's Project Engineers.
- d. Magnetic Particle Examination:
  - d1. All welded joints in ferritic material tanks, including nozzle welds, shall be inspected by this method.
  - d2. All magnetic particle inspection shall be per the ASME Code, Section VIII, Appendix 6, and as approved by the DISTRICT's Project Engineers.
  - d3. All nozzle welds shall be inspected, both inside and outside the tank, by the magnetic particle method.
  - d4. Welds on all internal piping shall be tested by the magnetic particle method.
  - d5. All unacceptable defects shall be repaired by procedures reviewed and accepted by the DISTRICT's Project Engineers.
- e. Tank Interior Coating Testing:
  - e1. The interior coating of tanks shall be tested for integrity after installation and curing for pinholes, bonding, etc., by an appropriate test.
  - e2. The interior coating of tanks shall be tested to determine the thickness of the coating applied.
  - e3. The minimum acceptable lining thickness shall be the specified nominal thickness.
  - e4. Test procedures for the above shall be submitted for review to the DISTRICT's Project Engineers. No testing work shall be done until these procedures are acceptable to the DISTRICT's Project Engineers.
  - e5. Results of all tests shall be documented and submitted to the DISTRICT's Project Engineers with a sketch showing areas examined.
  - e6. DISTRICT reserves the right to witness all tests and should be notified 72 hours prior to the start of any testing.

## 204. FABRICATION REQUIREMENTS

### 204.1 Material Cutting:

- a. Carbon steel may be cut to size or shape by machining, shearing, or thermal cutting. Stainless steel may be cut to size or shape by machining or shearing.
- b. Thermal cutting shall be followed by the removal of approximately 1/32 inch from the cut surfaces by machining or grinding. The finished edge shall be free of irregularities greater in depth than 1/16 inch in any 1/4 inch length.

### 204.2 Welding:

- a. All welding shall be performed in accordance with written qualified welding procedure specifications, which are in accordance with the ASME Boiler and Pressure Vessel Code, Section IX.

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- b. All welder's performance shall be qualified in accordance with the ASME Boiler and Pressure Vessel Code, Section IX.
- c. Welding shall not be performed when the surfaces to be welded are wet with rain, snow, or ice; when rain or snow is falling on such surfaces; or during periods of high winds unless the welder and the work are properly shielded.
- d. No welding shall be performed when the ambient temperature in the immediate vicinity of the weld is below 0°F. When the ambient environmental temperature is below 0°F, a heated structure or shelter around the area being welded may be used to maintain the ambient temperature in the immediate vicinity of the weldment at 0°F or higher. When the base metal temperature is below 32°F, the base metal within 3 inches of where weld metal will be deposited shall be heated to a minimum temperature of 70°F, which shall be maintained during welding.
- e. Welding shall be planned and conducted to minimize warping or distortion.
- f. All welds shall be cleaned of slag and flux between passes and following the final deposit. Stainless steel wire brushes shall be used on stainless steel and aluminum welding.
- g. All double-welded joints shall be back-chipped or arc-gouged to sound metal prior to depositing the second side. Arc gouging is only allowed for ferritic materials.
- h. Welded joints shall not be peened.
- i. Wide welds to overcome poor fit are not permissible. Poor fits shall be remedied by suitable means and approved by DISTRICT.

#### 204.3 Welded Joint Types:

- a. All shell joints shall be double-welded, full-penetration butt joints.
- b. All bottom joints in tanks (except flat-bottom tanks) shall be double-welded, full-penetration butt joints. Lap joints may be used for tanks with flat bottoms fully supported on foundations or grade.
- c. Conical roof-plate joints may be single-welded, full-fillet lap joints. The overlap shall be 5 times the plate thickness but need not exceed 1 inch. The roof plates inside the tank shall be seal welded to each other and to the top angle.
- d. All other roof-plate joints shall be double-welded, full-penetration butt joints.
- e. All nozzle to vessel welds shall be full-penetration welds. If reinforcement pads are used, they shall be welded per the applicable vessel code.

#### 204.4 Reinforcements:

- a. Openings in tank shells which are located below the overflow level and which are larger than required to accommodate a 2-in. standard weight coupling shall be reinforced to replace the cross-sectional area of the hole. Reinforcements may be in the nozzle or in the shell, or both.
- b. The minimum cross-sectional area of the reinforcement shall be not less than the product of the diameter of the hole, in inches, cut in the shell and the shell-plate thickness.

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- c. The portion of the nozzle neck that may be considered as reinforcement is that area lying within 4 times the nozzle wall thickness of both the inside and outside shell surface, plus the area lying within the shell-plate thickness.
- 204.5 Personnel Loading: Roofs and bottoms shall be designed to support maintenance personnel working on the tank.
- 204.6 Vessel Supports and Anchors:
- Supports for raised tanks, and anchor plates or anchor rings for flat-bottom tanks shall be provided as indicated herein. Horizontal tanks shall have a maximum of two supports.
  - Supports shall have holes for bolting to the floor.
  - Supports for raised tanks shall be attached to the tank with pads or saddles as required to distribute the load on the tank.
  - Supports for raised tanks shall be of such height as to position the lowest part of tank shell 24 inches above the floor unless otherwise indicated herein.
  - Stainless steel tanks with carbon steel supports shall be provided with a stainless steel pad of adequate thickness between the dissimilar materials.
- 204.7 Concentrated Acid Tanks:
- Acid tank interiors shall be as free as possible from crevices or pockets where dilute acid condensation can collect.
  - Vertical tanks shall have self-supporting roofs with full penetration welds.
  - The connection of the roof to the shell shall be designed to eliminate any internal pockets.
  - Full penetration welds shall be used on all surfaces contacting the liquid, except that the bottom plate weld to the shell of the vertical tank may be full fillet weld inside and out.
  - Carbon steel materials of unlined tanks shall have a corrosion allowance included in the calculated thickness of the shell, heads, roof, and all internals as follows:
- | <u>Mean Tank Wall Temperature (°F)</u> | <u>Corrosion Allowance (in.)</u> |
|--|----------------------------------|
| 60 or less                             | 1/16                             |
| 70 or less                             | 1/8                              |
| 80 or less                             | 1/4                              |
- \*Note: The nominal thickness for the above items shall be at least ½ inch.
- Air shall be vented into the tanks through a C. M. Kemp Model DB-20 dry breather, with a Model DBR-2 reactivator (or approved equal). A larger model shall be used if required by the acid inflow rate stated in this Specification.
- 204.8 Concentrated Caustic Tanks:

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- a. Carbon steel materials of unlined tanks shall have a 1/16 inch corrosion allowance included in the calculated thickness of the shell, heads, roof, and all internals. The minimum nominal thickness of these items shall be ½ inch.
- b. Carbon steel caustic storage tanks shall preferably be shop fabricated. The tank shall be postweld heat treated by heating the tank to 1100°F to 1150°F, holding for one hour, and allowing furnace to cool. Procedure for postweld heat treatment shall conform to the applicable requirements of paragraph UW-40 of Section VIII, Pressure Vessels – Division 1, ASME Boiler and Pressure Vessel Code.
- c. If the tank size prevents complete shop fabrication, CONTRACTOR shall use design and erection procedures that keep the number of field welds to an absolute minimum. The following requirements shall apply as a minimum:
  - d. All fittings penetrating the tank shall be installed and postweld heat treated in the shop.
  - e. All shop welds shall be postweld heat treated in accordance with Article b.
  - f. Brackets, fitup lugs, etc., should be minimized and installed on the exterior of the tank.
  - g. Field welding using small diameter electrodes with multiple passes is favored because the first passes will be partially heat treated. Additionally, small diameter electrodes limit the heat input and the effect on the tank interior. On double-welded joints, the inside weld shall be done first.
  - h. Full penetration butt welds shall be used on all surfaces connecting the caustic, except that the bottom plate weld to the shell of vertical tanks may be full fillet weld inside and out.
- 204.9 If specified herein, CONTRACTOR shall furnish and install supports for external pipes by others, where the pipe nozzle is in the upper portion of a vertical tank. For dimensional purposes, the pipe will be a vertical riser with the centerline determined by a long-radius elbow attached to the nozzle.
- 204.10 Shop-fabricated tanks shall be shipped in one piece. References herein to field work on shop-fabricated tanks shall apply to the CONTRACTOR who erects the tank.
- 205. FINISH REQUIREMENTS
- 205.1 Cleaning:
  - a. After fabrication and immediately prior to the painting or coating process, the tanks shall be shop cleaned as specified in MSS-1803-01 of this Specification and as follows.
    - a1. Solvent Cleaning:
      - a1.1 Solvent cleaning shall be used primarily to remove oil and grease and shall conform to the applicable requirements of SSPC Surface Preparation Specification No. 1, Solvent Cleaning.
      - a1.2 Solvent cleaning shall also include removal of soil, cement spatter, drawing compounds, salts, and other foreign matter as set forth in the previously mentioned SSPC Specification.
      - a1.3 No flammable or toxic cleaner shall be used.
    - a2. Hand Cleaning:

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- a2.1 Hand cleaning shall be used primarily to remove loose mill scale, loose rust, and loose paint, and also all slag, weld spatter, and alkaline scale from welded surfaces, by the use of hand brushing, hand sanding, hand scraping, hand chipping, or other hand impact tools, and shall conform to the applicable requirements of SSPC Surface Preparation Specification No. 2, Hand Cleaning.
- a2.2 Oil, grease, and salts shall first be removed by Solvent Cleaning as hereinbefore specified.
- a3. Power Tool Cleaning:
  - a3.1 Power tool cleaning shall be used primarily to remove loose mill scale, loose rust, and loose paint, and also all slag, weld spatter, and alkaline scale from welded surfaces by the use of power wire brushes, power impact tools, power grinders, power sanders, or a combination of these methods, and shall conform to the applicable requirements of SSPC Surface Preparation Specification No. 3, Power Tool Cleaning.
  - a3.2 Power tool cleaning shall be used as required to supplement Hand Cleaning and/or shall be used where specified or directed.
  - a3.3 Oil, grease, and salts shall first be removed by Solvent Cleaning as hereinbefore specified.
- a4. Commercial Blast Cleaning:
  - a4.1 Commercial blast cleaning shall be used to remove mill scale, rust, rust scale, paint, and foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels, and shall conform to the applicable requirements of SSPC Surface Preparation Specification No. 6, Commercial Blast Cleaning. Only shot shall be used on interior surfaces contacting the liquid.
  - a4.2 Heavy deposits of oil and grease shall first be removed by Solvent Cleaning as hereinbefore specified.
  - a4.3 Excessive rust scale shall be removed by Hand Cleaning or Power Tool Cleaning, as hereinbefore specified, prior to blast cleaning.
- a5. Blast Cleaning to "White" Metal:
  - a5.1 Blast cleaning to "white" metal shall be used for the same purpose as Commercial Blast Cleaning, and shall conform to the applicable requirements of SSPC Surface Preparation Specification No. 5, Blast Cleaning to "White" Metal. "White" metal is defined to mean a surface with a gray white, uniform metallic color, slightly roughened to form a suitable anchor pattern for coatings.
  - a5.2 The depth of anchor pattern shall be as required by the coating manufacturer or as specified herein.
  - a5.3 Heavy deposits of oil and grease shall first be removed by Solvent Cleaning as hereinbefore specified.
  - a5.4 Excessive rust scale shall be removed by Hand and/or Power Tool Cleaning, as herein specified, prior to blast cleaning.
  - a5.5 Only shot shall be used on interior surfaces.
  - a5.6 Interior weld seams shall be ground smooth and level. All corners must be smoothly rounded and ground to a 1/4-in. minimum radius prior to beginning the blast cleaning operation.
  - a5.7 On all work where welding has been done, all surfaces shall have the slag and weld spatter removed and shall be cleaned by Power Tool Cleaning.

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- a6. Cleaning of Stainless Steel Tanks:
  - a6.1 After fabrication and testing and before flushing out with demineralized water, the interior and exterior surfaces of stainless steel tanks shall be thoroughly cleaned to be free of grease, oil, weld spatter, chips, or other foreign materials. Visual examination will be made to assure that no traces of foreign matter remain on surfaces in contact with the fluid and to assure that particulate matter that could damage or foul other system components is eliminated. After testing, the interior surfaces shall be flushed out with demineralized water. Cleaning shall be done to the complete satisfaction of the DISTRICT.
  - a6.2 Where visual examination is not possible, cleaning will be obtained by thorough flushing with demineralized water.
  - a6.3 Special emphasis shall be placed upon keeping interior surfaces completely free of all foreign matter, corrosion products, and corrosion production elements. Proper cleaning and shipping procedures must be precisely followed. If sulfur-containing oils are used during manufacturing, the fluid side of the equipment shall be cleaned and degreased prior to shipment. Cleaning and degreasing solvents shall be halide-free, i.e., chlorinated or fluorinated solvents shall not be used.
  - a6.4 Care must be taken to avoid the use of any compounds or other chemicals during fabrication or production that contains chlorides or other constituents capable of inducing stress corrosion in stainless steel tanks.
- a7. The surface preparation for all field touchup painting shall be the same as specified for the shop painting.
- b. Aluminum Tanks: Cleaning of aluminum tanks shall be as specified for stainless steel tanks, except that the exterior surfaces shall also be cleaned to remove stains, discolorations, and shipping or erection marks.
- c. The surface preparation for all field touchup painting shall be the same as specified for the shop painting.
- 205.2 Interior Coating:
  - a. All welding, machining, cutting operations, hydrostatic testing, nondestructive testing, and cleaning procedures must be completed prior to the application of interior coatings to tanks.
  - b. Rubber linings or spray-on-type coatings, which are necessary for corrosive applications, shall be compatible with the pH, temperature, and chemical concentrations of the stored solution. The lining or coating thickness shall be as specified herein. However, in no case shall the thickness of the rubber linings be less than 3/16 in. The method of surface preparation prior to application of the lining shall be "white" metal blasting in accordance with SSPC Surface Preparation Specification No. 5.
    - b1. Linings shall conform to the surface of the tank with no folds, bulges, or corner gaps. Application of the lining shall be continuous and shall extend to and cover the inside of pipe nozzles, flange faces, manhole covers, and tank covers. No welding shall be done after linings are in place. Hinge material for hinged tank covers shall be as approved.
    - b2. Lining shall be applied by a licensed lining applicator in strict accordance with lining manufacturer's recommendations.

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- b3. It is essential that the shot blasting, if done by the tank manufacturer, be supervised by the licensed lining applicator since the internal prime coat must be applied immediately after blasting is completed to the licensed lining applicator's satisfaction. It is preferred, however, that the lining applicator does its own shot blasting.
  - b4. Any defects or deficiencies revealed by the tests shall be remedied by CONTRACTOR.
  - b5. All costs incurred due to the lack of integrity of the lining will be chargeable to the CONTRACTOR.
  - b6. CONTRACTOR shall state its guarantee of both its workmanship and the suitability of the lining for dilute acid and alkaline solution.
  - c. Interior Spray-On Coatings: Spray-on-type coatings shall be compatible with the pH, temperature, and chemical concentration of the stored solution. The coating thickness shall be as specified herein.
- 205.3 Painting (Refer to Painting Table MSS-1803-01):
- a. After cleaning, the tanks shall be shop prime coat painted in accordance with Painting Table MSS-1803-01.
  - b. Alternate to Shop Painting for Field-Erected Tanks:
    - b1. CONTRACTOR may clean and paint the tank in the field instead of in the shop. Cleaning and painting in the field shall conform to all requirements specified for shop cleaning and painting.
    - b2. Field cleaning and painting shall be done after erection and successful testing of the tank.
    - b3. If so specified herein, internal tank painting may be done prior to leak testing. The minimum drying time of the final coat shall be as recommended by the paint manufacturer. If the tank will be filled with potable water, it shall be disinfected before leak testing. Responsibility for disinfecting shall be as specified herein.
  - c. Field Touchup Painting:
    - c1. Field touchup painting shall be done on the following surfaces after they have been properly cleaned as herein specified:
    - c2. Surfaces where the shop coat of paint has been marred, scratched, or otherwise damaged, due to shipping, handling, erection, installation, weathering, etc.
    - c3. Heads of field bolts and nuts, and adjacent surfaces left unpainted in the shop.
    - c4. Surfaces of field welds and adjacent surfaces left unpainted in the shop.
    - c5. Surfaces of any ferrous fasteners not otherwise protected.
    - c6. Exposed fabrication, erection, or shipping marks shall be cleaned off and the areas touchup painted to match the adjacent surfaces.
    - c7. Surface preparation, number of coats, and dry film thickness shall be the same as specified for shop painting. The same paint as used for the shop coat shall be used for the field touchup.

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- c8. Touchup painting shall overlap the prime coat by not less than one inch all around to ensure continuity of coating.
- c9. Galvanized surfaces which have been marred due to handling, shipping, erection, weathering, field welding, etc., shall be touched up with one coat of Galvanox paint as made by Sub Ox. Paint coverage shall result in at least one ounce of zinc metal per square foot of surface. Touchup galvanizing shall overlap the original coating by not less than one inch all around to ensure continuity of coating.
- d. Paint Application:
  - d1. Application of paint shall conform to the applicable requirements of SSPC Paint Application Specification No. 1, Shop, Field, and Maintenance Painting, and to the requirements herein specified.
  - d2. Time Restrictions: The prime coat shall be applied within the following time limitations after completion of specified surface preparation:
    - d2.1 Solvent Cleaning, Hand Cleaning, or Power Tool Cleaning – 24 hours
    - d2.2 Commercial Blast Cleaning or Blast Cleaning to White Metal – 8 hours
    - d2.3 The 8 hours indicated for blast cleaning is approximate depending on the temperature and humidity. The main criteria are that no rust bloom forms on the prepared surface prior to application of the prime coat. If any rust bloom does form, the surface shall be re-prepared before applying the prime coat.
  - d3. Temperature Restrictions:
    - d3.1 Paint shall not be applied when the surrounding air temperature is below 40°F or when the temperature is expected to drop to 32°F before the paint has dried.
    - d3.2 Paint shall not be applied to steel surfaces which are more than 5°F below the surrounding air temperature, or which are at a temperature of less than 35°F.
    - d3.3 Paint shall not be applied to steel surfaces which are at a temperature of over 125°F unless the paint is specifically formulated for application at the specific temperature. When steel is painted in hot weather, precautions shall be taken to ensure that the specified dry mil thickness of paint is obtained.
  - d4. Moisture and Humidity Restrictions:
    - d4.1 Paint shall not be applied in rain, snow, fog, or mist, or when the relative humidity results in condensation on metal surfaces due to the difference in temperature between the metal and the surrounding air, or when frost has formed on such surfaces. Percent Relative Humidity Table MSS-1803-02 shall be used as a guide for relative humidity restrictions.
    - d4.2 All surfaces shall be perfectly dry before and during painting.
- e. Special Requirements for Aluminum Tanks:
  - e1. In general, flat-bottom aluminum tanks will rest on a concrete ringwall foundation with a sloped oil-filled sand cushion. CONTRACTOR shall furnish and install a suitable membrane such as ½ inch, asphalt impregnated fiberboard over the top of the ringwall to protect the underside of the bottom plate.
  - e2. CONTRACTOR shall clean and field paint the exposed portion of carbon steel anchor bolts in place by others in accordance with Table MSS-1803-01.

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- e3. Aluminum tanks may occasionally be located indoors and supported on carbon steel floor framing by others. CONTRACTOR shall field clean and paint the carbon steel contact surfaces in accordance with Table MSS-1803-01.
- e4. It is intended that galvanic corrosion between aluminum and incompatible materials be minimized by having two coats of paint on the contact surfaces. The two coats shall be applied immediately before installing the aluminum and shall be applied to either the incompatible material or the aluminum as specified in Painting Table 1803-01.

### **PART 3 – EXECUTION**

#### 206. ATTACHMENTS

- 206.1 Table MSS-1803-01, Shop Surface Preparation and Prime Painting Requirements for Various Materials
- 206.2 Table MSS-1803-02, Percent Relative Humidity Above Which Moisture Will Condense on Metal Surfaces Not Insulated

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**TABLE MSS-1803-01**

**FIELD SURFACE PREPARATION AND PRIME PAINTING REQUIREMENTS FOR VARIOUS MATERIALS**

Item	Field Surface Preparation	No. Coats	Type/Color	Shop Prime Paint		
				Dry Film Thickness (mil)	E. I. duPont	Detroit Graphite
<u>Carbon Steel</u>						
Exterior of tank and accessories	Solvent & Commercial Blast Cleaning	1	Alkyd/PPG Industries Florentine Gold	2	67-Y-746	501LF Prime Rite
Exterior of surfaces which cannot be finish painted after erection (concealed surfaces)	Solvent & Commercial Blast Cleaning	2	First: Alkyd/TBD	2	67-Y-746	501LF Prime Rite
			Second: Alkyd/PPG Industries Florentine Gold	2	96-67640	30 Superior Graphite
Surfaces within 3 in. of a field weld, faying surface under connection angles	Solvent & Commercial Blast Cleaning	None	None	None	None	None
Interior surfaces (unlined) and inside accessories	Solvent & Commercial Blast Cleaning	None	None	None	None	None
Surfaces embedded in concrete and the underside of the bottom plate	None	None	None	None	None	None
<u>Stainless Steel</u>						
Tank exterior, interior, and accessories	Subsection 8.8	None	None	None	None	None
Surfaces embedded in concrete	Solvent and Hand Tool	2	Silicone	As rec. by paint	Dabney Co. Thumalox 70	

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Item	Field Surface Preparation	Shop Prime Paint				
		No. Coats	Type/Color	Dry Film Thickness (mil)	E. I. duPont	Detroit Graphite
	Cleaning or Power Tool Cleaning (if required)			mfgr.	Chloride-free	
<u>Aluminum (Subsection 10.5)</u>						
Tank exterior, interior, and accessories	Subsection 8.9	None	None	None	None	None
Surfaces in contact with ferrous metals (other than galvanized steel), and nonferrous metals incompatible with aluminum (such as copper or lead). Apply to surface in contact with aluminum.	Solvent & Commercial Blast Cleaning	2	First: Alkyd/Brown Second: Alkyd/Black	2 2	67-Y-746 96-67640	500 Prime Rite 30 Superior Graphite
Surfaces in contact with concrete or masonry. Apply to aluminum, concrete, or masonry.	As specified in Project Specification	2	First: Acrylic Latex/White Second: Acrylic Latex/Selected	4 to 6 each	Lucite House Paint	4000
Underside of bottom plate in contact with ringwall foundation	None	Subsection 10.5	Subsection 10.5	Subsection 10.5	Subsection 10.5	Subsection 10.5
Surface embedded in concrete or masonry, apply to aluminum	As specified in Project Specification	2	Acrylic Latex 1 <sup>st</sup> coat white 2 <sup>nd</sup> selected	4 to 6 each	Lucite House Paint	4000

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**TABLE MSS-1803-02**

**PERCENT RELATIVE HUMIDITY ABOVE WHICH MOISTURE  
WILL CONDENSE ON METAL SURFACES NOT INSULATED**

Metal Surface Temp., °F	Surrounding Air Temperature, °F												
	40	45	50	55	60	65	70	75	80	85	90	95	100
35	60	33	11	--	--	--	--	--	--	--	--	--	--
40	--	69	39	50	8	--	--	--	--	--	--	--	--
45	--	--	69	45	27	14	--	--	--	--	--	--	--
50	--	--	--	71	49	32	20	11	--	--	--	--	--
55	--	--	--	--	73	53	38	26	17	9	--	--	--
60	--	--	--	--	--	75	56	41	30	21	14	9	--
65	--	--	--	--	--	--	78	59	45	34	25	18	13
70	--	--	--	--	--	--	--	79	61	48	37	29	22
75	--	--	--	--	--	--	--	--	80	64	50	40	32
80	--	--	--	--	--	--	--	--	--	81	66	53	43
85	--	--	--	--	--	--	--	--	--	--	81	68	55
90	--	--	--	--	--	--	--	--	--	--	--	82	69
95	--	--	--	--	--	--	--	--	--	--	--	--	83

END OF SECTION 434120

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